We claim:

1. A method of forming a PGO thin film on a high-k dielectric comprising:

preparing a silicon substrate, including forming a high-k gate oxide layer thereon;

patterning the high-k gate oxide;

annealing the substrate in a first annealing step;

placing the substrate in a MOCVD chamber;

depositing a PGO thin film by injecting a PGO precursor into the MOCVD chamber; and

annealing the structure having a PGO thin film on a high-k gate oxide in a second annealing step.

2. The method of claim 1 which includes preparing a precursor solution by mixing $[Pb(thd)_2]$, where thd is $C_{11}H_{19}O_2$, and $[Ge(ETO)_4]$, where ETO is OC_2H_5, in a molar ratio of between about 5 to 5.5:3; dissolving the mixture in a mixed solvent taken from the group of solvents consisting of butyl ether, and tetrahydrofuran, isopropanol and tetraglyme in a molar ratio of about 8:2:1, so that the precursor solution has a concentration of 0.1 mole/liter of PGO.

3. The method of claim 2 wherein said injecting includes injecting the precursor solution into a vaporizer associated with the MOCVD chamber at temperature in the range of between about 150°C to 240°C, at a rate of 0.02 ml/min to 0.2 ml/min to form a precursor gas, while maintaining a feed line to the vaporizer at a temperature of between about 150°C to 245°C.

4. The method of claim 1 wherein said patterning includes patterning by a technique taken from the group of techniques consisting of chemical mechanical polishing (CMP) and etching

5. The method of claim 1 wherein said depositing a PGO thin films includes maintaining MOCVD chamber parameters, including maintaining the temperature in the MOCVD chamber in a temperature range of between about 500°C to 560°C; maintaining the pressure in the MOCVD chamber at between about one torr. to ten torr.; maintaining an oxygen partial pressure in the MOCVD chamber of between about 30% to 50%, holding the vaporizer temperature at a temperature range of between about 180°C to 200°C, and holding a vaporizer pressure at a pressure of between about 30 torr. to 50 torr., and providing a precursor solution delivery rate of between about 0.02 ml/min to 0.2 ml/min, and maintaining the MOCVD chamber parameters for a deposition time of between about one hour to three hours; and annealing the structure in a second annealing step at a temperature in a range of between about 500°C to 560°C for between about five minutes to 30 minutes in an oxygen atmosphere.

6. The method of claim 1 wherein said depositing a PGO thin films includes maintaining MOCVD chamber parameters, including maintaining the temperature at a deposition temperature of between about 500°C to 560°C at a pressure of between about 1 torr. to 10 torr, in an atmosphere having an oxygen partial pressure of between about 20% to 50%; a vaporizer temperature of between about 180°C to 200 °C; a chamber pressure of between about 30 torr. to 50 torr.; a precursor solution delivery rate of between about 0.02 ml/min to 0.1 ml/min, and a deposition time is in a range of between about five minutes to twenty minutes, depositing another layer of PGO on the PGO, wherein the deposition temperatures is between about 380°C to 420°C; the chamber pressure is between about five torr. and ten torr.; the chamber is maintained at an oxygen partial pressure of between about 30% to 40%, at a vaporizer temperature of between about 200°C to 240°C, and a solution delivery rate of between about 0.1 ml/min to 0.2 ml/min, for a deposition time of between about one hour to three hours; annealing the structure in a second annealing step in an oxygen atmosphere at a temperature in a range of between about 500°C to 560°C for between about five minutes to 30 minutes.

7. A method of forming a PGO thin film on a high-k dielectric comprising:

preparing a silicon substrate, including forming a layer of silicon dioxide thereon and forming a high-k gate oxide layer on the silicon dioxide;

patterning the high-k gate oxide;

annealing the substrate in a first annealing step at a temperature in a range of between about 400°C to 450°C for between about zero minutes and 40 minutes;

placing the substrate in a MOCVD chamber;

preparing a PGO precursor;

depositing a PGO thin film by injecting the PGO precursor into the MOCVD chamber; and

annealing the structure having a PGO thin film on a high-k gate oxide in a second annealing step.

8. The method of claim 7 wherein said preparing a precursor solution includes mixing $[Pb(thd)_2]$, where thd is $C_{11}H_{19}O_2$, and $[Ge(ETO)_4]$, where ETO is OC_2H_5, in a molar ratio of between about 5 to 5.5:3; dissolving the mixture in a mixed solvent taken from the group of solvents consisting of butyl ether, and tetrahydrofuran, isopropanol and tetraglyme in a molar ratio of about 8:2:1, so that the precursor solution has a concentration of 0.1 mole/liter of PGO.

9. The method of claim 8 wherein said injecting includes injecting the precursor solution into a vaporizer associated with the MOCVD chamber at temperature in the range of between about 150°C to 240°C, at a rate of 0.02 ml/min to 0.2 ml/min to form a precursor gas, while maintaining a feed line to the vaporizer at a temperature of between about 150°C to 245°C.

10. The method of claim 7 wherein said patterning includes patterning by a technique taken from the group of techniques consisting of chemical mechanical polishing (CMP) and etching

11. The method of claim 7 wherein said depositing a PGO thin films includes maintaining MOCVD chamber parameters, including maintaining the temperature in the MOCVD chamber in a temperature range of between about 500°C to 560°C; maintaining the pressure in the MOCVD chamber at between about one torr. to ten torr.; maintaining an oxygen partial pressure in the MOCVD chamber of between about 30% to 50%, holding the vaporizer temperature at a temperature range of between about 180°C to 200°C, and holding a vaporizer pressure at a pressure of between about 30 torr. to 50 torr., and providing a precursor solution delivery rate of between about 0.02 ml/min to 0.2 ml/min, and maintaining the MOCVD chamber parameters for a deposition time of between about one hour to three hours; and annealing the structure in a second annealing step at a temperature in a range of between about 500°C to 560°C for between about five minutes to 30 minutes in an oxygen atmosphere.

12. The method of claim 7 wherein said depositing a PGO thin films includes maintaining MOCVD chamber parameters, including maintaining the temperature at a deposition temperature of between about 500°C to 560°C at a pressure of between about 1 torr. to 10 torr, in an atmosphere having an oxygen partial pressure of between about 20% to 50%; a vaporizer temperature of between about 180°C to 200 °C; a chamber pressure of between about 30 torr. to 50 torr.; a precursor solution delivery rate of between about 0.02 ml/min to 0.1 ml/min, and a deposition time is in a range of between about five minutes to twenty minutes, depositing another layer of PGO on the PGO, wherein the deposition temperatures is between about 380°C to 420°C; the chamber pressure is between about five torr. and ten torr.; the chamber is maintained at an oxygen partial pressure of between about 30% to 40%, at a vaporizer temperature of between about 200°C to 240°C, and a solution delivery rate of between about 0.1 ml/min to 0.2 ml/min, for a deposition time of between about one hour to three hours; annealing the structure in a second annealing step in an oxygen atmosphere at a temperature in a range of between about 500°C to 560°C for between about five minutes to 30 minutes.